Wind River Watershed Restoration Project

Underwood Conservation District

Annual Report
2002 - 2003

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Wind River Watershed Restoration

2002-2003 Annual Report
for the period July 1 2002 to June 30 2003

February 2004

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Introduction

The goal of the Wind River project is to preserve, protect and restore Wind River steelhead. In March, 1998, the National Marine Fisheries Service listed the steelhead of the lower Columbia as "threatened" under the Endangered Species Act. In 1997, the Washington Department of Fish and Wildlife rated the status of the Wind River summer run steelhead as critical. Due to the status of this stock, the Wind River summer steelhead have the highest priority for recovery and restoration in the state of Washington's Lower Columbia Steelhead Conservation Initiative.

The Wind River Project includes four cooperating agencies. Those are the Underwood Conservation District (UCD), United States Geological Service (USGS), US Forest Service (USFS), and Washington State Department of Fish & Wildlife (WDFW). Tasks include monitoring steelhead populations (USGS and WDFW), Coordinating a Watershed Committee and Technical Advisory Group (UCD), evaluating physical habitat conditions (USFS and UCD), assessing watershed health (all), reducing road sediments sources (USFS), rehabilitating riparian corridors, floodplains, and channel geometry (UCD, USFS), evaluate removal of Hemlock Dam (USFS), and promote local watershed stewardship (UCD, USFS).

UCD's major efforts have included coordination of the Wind River Watershed Committee and Technical Advisory Committee (TAC), water temperature and water chemistry monitoring, riparian habitat improvement projects, and educational activities. Our coordination work enables the local Watershed Committee and TAC to function and provide essential input to Agencies, and our habitat improvement work focuses on riparian revegetation. Water chemistry and temperature data collection provide information for monitoring watershed conditions and fish habitat, and are comparable with data gathered in previous years. Water chemistry information collected on Trout Creek should, with 2 years data, determine whether pH levels make conditions favorable for a fish parasite, *Heteropolaria lwoffi*.
Educational activities further the likelihood that future generations will continue to understand and enjoy the presence of native fish stocks in the Wind River basin.

Objective 1: Coordination

<u>Task 1a:</u> **Facilitate monthly or bi-monthly meetings of the Wind River Watershed Council (WRWC).**

- Ten WRWC meetings were held during this period. Major accomplishments of the group include: a) revisiting the Wind River Watershed Enhancement Project (WEP) database, b) providing input to the WRIA29 planning process through chair Dan Gunderson, and c) assisting Skamania County in a planning effort to control eurasian milfoil in County waters.

- The WRWC chair represented the Council at 10 Water Resource Inventory Area 29 (WRIA) Planning Unit meetings.

<u>Task 1b:</u> **Facilitate quarterly meetings with TAC.**

- Four meetings of the Wind River/White Salmon Technical Advisory Committee (TAC) were held during the period. The group a) gave input regarding the White Salmon River Limiting Factors Analysis (LFA) being prepared by the Washington Conservation Commission, and b) coordinated budget and planning information regarding the various projects on the Wind River BPA contract. We decided at our April meeting that UCD should continue with the Wind River pH study for another year, due to low snowfall and resulting low runoff the previous year.
- Project review and prioritization was not completed, since the Ecosystem Diagnosis and Treatment (ETD) analysis was not yet available. EDT should be available for use in FY03.

Objective 2: Monitoring

Task 2g: **Monitor water quality and temperature at new and established baseline stations and use the data to determine if water quality is a limiting factor.**

- Continuous summer water temperature monitoring was completed with HOBO thermographs at Seven sites established by UCD. Eight (seven sites and one duplicate) HOBOs® were launched in May 2002. An additional two Hobos were added to the middle section of the Wind River in July 2002. All ten Hobos were retrieved in October 2002, and the data was downloaded. In May 2003 the loggers were checked for accuracy and launched at the same nine sites. The data has been forwarded to USGS for analysis, and will be shared with project partners, DOE, US Forest Service (USFS), and UCD Refer to the USGS 2002-2003 annual report for the temperature results.
- An evaluation of pH levels in the upper Trout Creek drainage began in August 2002. Samples were collected on sixteen occasions from five sites between August 2002 and June 2003. Monthly samples were collected, as well as weekly samples during the month of November, and during the month of March (spring snowmelt). The data collected includes general water chemistry using UCD's equipment for pH, turbidity, conductivity, dissolved oxygen, and temperature. In addition, bottles of water are filled and sent to a contracted laboratory (Columbia Analytical Services) for analysis of alkalinity (ALK), total suspended solids (TSS), sulfate (SO_4), and tanins and lignins (TAN_LIG).(Note that TAN-LIG are not sampled on every occasion due to cost). Information for each monitoring parameter and the results are reported in appendix A.
- Snowpack and resulting snowmelt was very light in winter 2002-3, so the spring flush was probably not very representative. The November rains were also weak, as such only 3 weeks were sampled during November as the weather was dry and river was still experiencing fall base flow conditions In consultation with USGS and USFS we have decided to continue this sampling for one more year.
- UCD assisted USGS complete two water quality sampling rounds in spring 2003. Data collected included low level nutrients in the Wind River Drainage .
- Water Quality Monitoring program update. UCD has completed an update of Water Quality Monitoring Standard Operating Procedures equipment used by UCD. Standard Operating Procedures (SOPs) were developed for measuring Turbidity, pH, , Dissolved Oxygen, Conductivity, and for collecting samples for laboratory analysis (e.g. Total suspended solids, alkalinity). We will apply these SOPs to all water quality monitoring projects, including Wind River data collection.

Objective 3: Assessment

Task 3a: **Update assessment data, revise list of needed projects, and prioritize the list based on value and likely success of desired outcomes.**

EDT results were not available during 2002, so were not used in assessing Wind River projects.

- In Winter 2003, Jim White reviewed the Wind River Watershed Enhancement Project (WEP) list. The database (a Microsoft Excel spreadsheet) does not clearly identify project priorities, and does not identify project status (i.e. which projects are done, which have been dropped etc.). Working with Susan James of the Northwest Service Academy, Jim was able to update the status of most projects on the list.
- In January 2003, the TAC participated in a review of the Wind River Draft Limiting Factors Analysis and provided input. The LFA was completed in spring, 2003 by the Washington Conservation Commission.
- In March and April 2003, the WRWC reviewed the list of projects on the Wind River WEP list. Projects that were confirmed as still having high priority were the Little Wind River slides, and the Hot Springs trail slides. Field visits to these sites were made in May 2003.
- The Wind River Total Maximum Daily Load (TMDL) report was reviewed by the Wind River Watershed Committee on two occasions. The TMDL report is being finalized this summer. This report will be useful in assessing priority areas for restoration work on the Wind system.

Objective 4: Restoration

Task 4 b and Task 4c: Place key pieces of LWD to achieve the range of natural variability for the Wind River watershed (75-120 pieces/mile), and plant and thin riparian forest to increase stream shade, provide future LWD and channel stability.

- Subtask a), Stabler Cutbank Project. During winter and spring 2003, photodocumentation was made twice at this site. The channel stabilization work still appears to be holding quite well. Development of riparian plants along the river bank are proceeding slowly. We plan to do additional planting in spring 2004.
- Subtask b), Jersik reforestation. In summer 2002 some scotch broom was removed from the site by a Northwest Service Academy crew. We replanted much of the 2002 planting in March. Reforestation had largely failed, as a result of using 100% western redcedar with little or no browsing protection. The landowner apparently was not aware of the animal damage potential. Replanting was accomplished with Douglas-fir and western white pine.
- Subtask c), Sandberg reforestation. UCD worked with landowner John Sandberg to develop a cost-share approach to reforesting the river

bank on his property. A heavy infestation of scotch broom has become established on the site. Initial plans (summer 2002) were to have the landowner spray the plants with herbicide, and reforest in spring 2003. On further examination, we decided that was not a good plan. A survey done in winter 2003 showed that the scotch broom is 4 to 6 feet tall, and is very dense (200 to 1000 stems per acre). It would take an enormous amount of herbicide to kill the plants, and we would still have the dead vegetation to content with. In addition, a fall freeze at the Lave Nursery (Parkdale, OR) meant that UCD lost about ½ of trees planned for use in spring 2003. We decided to (1) cut the scotch broom plants on the property in 2002, (2) have the landowner chip or pile/burn the scotch broom slash, (3) have the landowner spray the remaining small and newly germinating scotch broom in fall 2003, and have UCD plant the site in 2004. We accomplished the scotch broom removal via NWSA in April and May 2003.

- Subtask d), Price Properties Reforestation. Approximately 3 acres were replanted on Price properties in March 2003. Planting was with Douglas-fir (about 70% of seedlings), western white pine (10%), grand fir (10%), and western redcedar (10%). Western redcedar and about ½ of the Douglas-fir were protected from animal damage with plastic mesh tubing, or with slash piled around the planted tree. About ½ of the planted area was in land planted in the past, where the planting had totally failed.
- Subtask e and f), Middle Wind River Reach Geomorphology. Survey work was accomplished and a report was prepared by Russ Lawrence, former Clark CD Engineer. Actual work on Phase 1 was halted when, in December 2002, the Landowner would not agree to leave improvements resulting from the project in place for 10 years.
- Subtask g), Sand Hill Slides stabilization. The Cluster Engineer did not have time to pursue this project, and left the Clark CD at the end of the Fiscal Year. Since neither Skamania County nor UCD had the personnel to accomplish the task, we turned back this grant. Some reforestation was done at the base of this slide in previous years.

Objective 5: Education
Task 5a, School Support:
Chillers: Two Chillers were purchased and used by Carson Elementary School. The chillers are kept by one of our partners, the US Fish and Wildlife Service's Columbia Gorge Information/Education Office. The Information/Education Office uses them in various educational efforts in Stevenson and Carson.
Career Day: Presentations were done at Columbia Gorge Community College for the annual Career Day attended by 5 area high schools. The topic presented was careers for women in natural resources.
The Kanaka Creek Adopt-A-Stream program This program was continued with a field trip by about 20 Wind River Middle School Outdoor Education program students in April 2003, with UCD participating. Fieldwork accomplished included water quality measurements and macro-invertebrate identification.

Task 5b, Public Information:

Skamania County Fair: The traveling Wind River Watershed Display Board was updated with current information on the Middle Wind River Project and recognition through Forest Service "Rise to the Future" award. The Board was displayed at the Skamania County Fair for 5 days and received a Blue Ribbon.
Wind River Watershed boundary signs: A total of 5 new watershed delineation signs replaced signs, which were damaged or missing. The Skamania County Roads Dept and US Forest Service installed these signs.
Arbor Day: UCD participated in Arbor Day by giving away free trees in Stevenson on April 9. Over 600 trees were distributed to individuals during the day. In addition, dozens of contacts were made, and Forest management advice was provided to two landowners. A press release accompanied the Arbor Day event.
TMDL: As mentioned earlier, Total Maximum Daily Load (TMDL) planning for the Wind River was featured in two Wind River Watershed Council meetings (July 2002 and May 2003), with presentations from Dave Howard of Washington DOE.

Task 5c: Provide technical assistance to landowners and agency personnel to develop water resource and habitat enhancement measures for projects on watershed lands.

UCD provided technical assistance in the form of project recommendations to 4 landowners in the Middle Wind, and one in the lower Wind. In addition, technical advice was provided to individuals during Skamania County Fair, Arbor Day, Wind River Watershed Council meetings, and to individuals during walk-in or phone-in contacts.

Report F: Budget Summary

Expenditures by Category:

Underwood Conservation District
Wind River Watershed Project
BPA Project No. 98-019-04
July 1, 2002- June 30, 2003

Category	Expended	Unexpended
Personnel:	47624.96	(495.96)
Supplies:	1488.67	4361.33
Overhead:	5139.67	2039.33
Travel:	1156.46	1543.34
Subcontractors:	13559.25	(2459.25)
Other:	843.60	4156.40
Total:	69812.61	9145.39

Appendix A

Trout Creek pH Assessment
Annual Report
For the period: August 2002-June 2003.

Prepared by Jim White and Rozalind Plumb
(Underwood Conservation District)

Introduction

The following reports the results obtained from the Trout Creek pH Assessment. The pH monitoring program is intended to systematically sample (by season and location) portions of the Trout Creek sub-basin to determine if low pH (acid) surface waters exist.

Trout Creek represents an important summer steelhead spawning and rearing tributary of the Wind River. Recent fish health studies by US Geological Service Columbia River Research laboratory (CRRL) and US Fish and Wildlife Service (USFWS), have observed the presence of the fish parasite *Heteropolaria lwoffi,* in the Trout Creek basin and surrounding watersheds. This parasite has been associated with low pH levels in waters. This study is aimed at providing data to assist in understanding the mechanisms of the parasite, and to see what conditions make Trout Creek favorable.

UCD, along with CRRL, and US Forest Service created a monitoring schedule and determined which parameters to assess. UCD performed general water chemistry assessments on site for pH, conductivity, dissolved oxygen, and turbidity. Advanced laboratory assessments for alkalinity, total sulfate, total suspended solids and tannins and lignins, were carried out by an approved laboratory. Although pH is the main parameter of interest in this study, the general chemistry parameters were taken to obtain an overall picture of the health of the creek. The advanced laboratory parameters were assessed so the potential source of low pH could be identified (e.g. Sulfate levels may indicate geothermal influences, and Tannins and Lignins may indicate wetland/soil influences).

The frequency of sampling was set at once per month. This would allow for the identification of seasonal variations. In addition, weekly sampling would take place during the months of March and November. These two months were seen as critical as they most often encounter the spring snow melt (March) and the first hard rains after the summer (November). During such times the water quality may be adversely affected by accumulations of factors influencing pH (e.g. the topsoil following a dry summer may enter the creek carrying acidic elements. Snow melt is thought to be a carrier of sulfates from acid rain/ precipitation).

Table 1 Site locations and analyses carried out during 2002-2003 performance period.

Site ID	Site Description	Distance from mouth of Wind River (km)	General water chemistry (pH, Conductivity, turbidity, DO, temp)	Advanced Chemistry (Alkalinity, TSS, Sulfate, Tannin/Lignin*)
4a	Trout Creek at USFS 43 road	27.29	●	●
4d	Crater Creek	31.46	●	●
4b	Compass Creek	32.54	●	●
4f	Trout Creek at USFS 42 Road	32.03	●	●
4g	Trout Creek at gravel pit	33.15	●	●

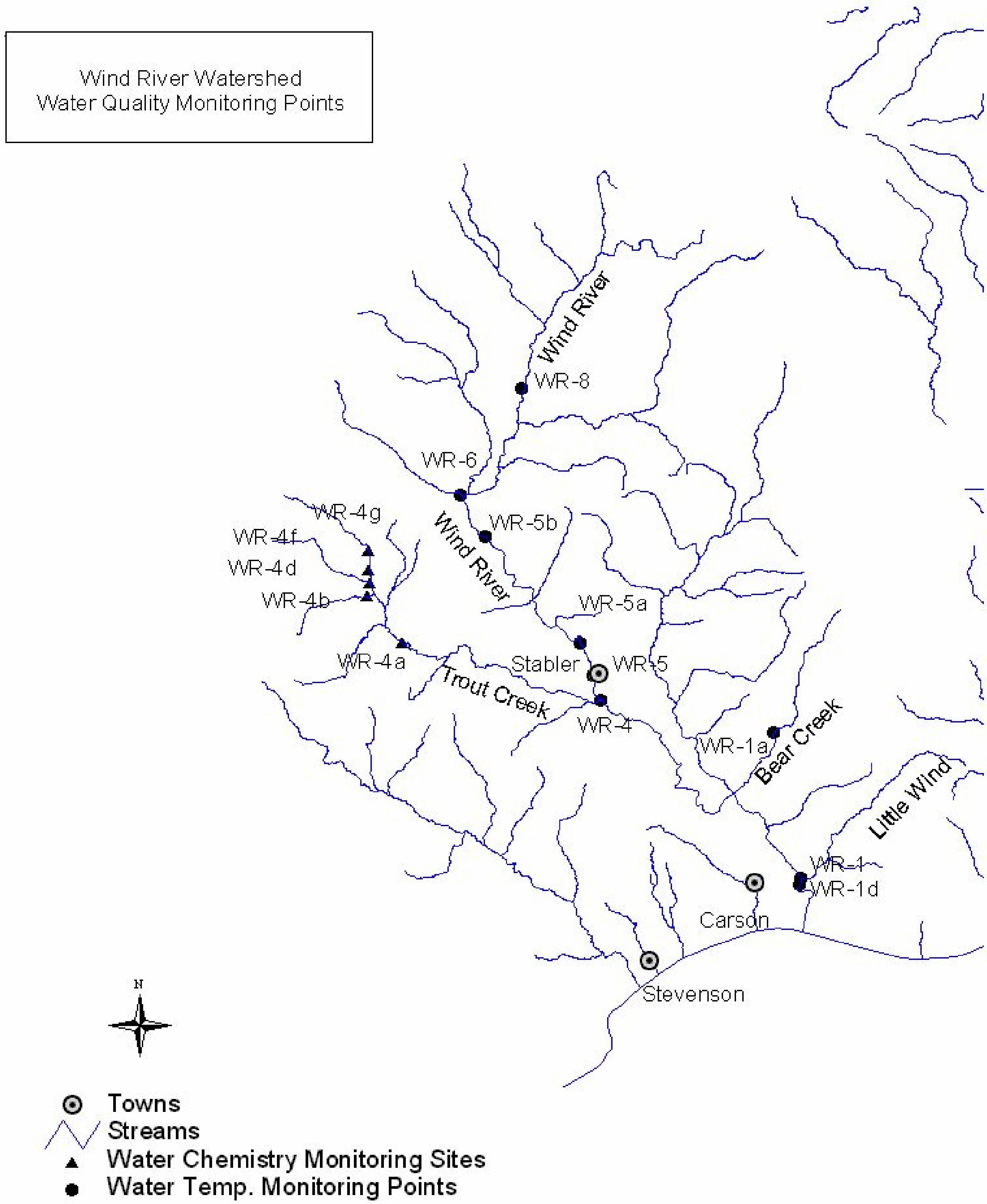

Figure 1. map of Wind River sampling sites (historic and current).

Table 2. List of monitoring parameters used.

General Water Chemistry	Method
pH (acidity)	Orion 250A meter
Conductivity	Orion 126 meter
Water Temperature	Hanna HI 90-60 digital thermometer
Air Temperature	Alcohol bulb thermometer
Turbidity	HACH 2100P
Dissolved Oxygen	YSI 55/12 meter (and HACH modified Winkler test kit for QA)
Advanced Laboratory Analyses	
Total Suspended Solids (TSS)	EPA 160.2
Alkalinity, total as CaCO3	EPA 310.1
Sulfate	EPA 300.0
Tannins / Lignins	SM 5550 B

Table 3. Monitoring schedule

Site	**Monthly sampling** (12 rounds per year, except if inaccessible due to snow)	**Weekly sampling** (3 extra rounds per month in March and November)
4a Trout Creek at 43 road	•	•
4b Compass Creek	•	•
4d Crater Creek	•	•
4f Trout Creek at 42 road	•	•
4g Trout Creek at gravel pit	•	•

During the 2002-2003 project period sampling began in August and continued throughout the year. Weekly sampling began in November. However, the weather was unusually dry and sampling was stopped after the 3rd week as it was not representative of a wet season. Sampling continued on a monthly basis throughout the winter. The winter of 2002-2003 was unusually dry and there was hardly any snow. Due to the unusual weather it was determined that the sampling continue for another year so as to obtain a better representation of precipitation in the system. A complete set of data would include 18 sampling rounds. A total of 16 sets of data were collected between August 2002 and June 2003. July 2002 was missed as the project was still being planned, and the last week of November was not sampled due to lack of precipitation.

Parameter Review and Results.

Temperature

The temperature of water in a stream can adversely affect the biological and chemical processes that take place in the water body. ‘Aquatic organisms from microbes to fish are dependent on certain temperature ranges for their optimal health. Optimal temperatures for fish depend on the species: some survive best in colder water, whereas others prefer warmer water. Benthic macroinvertebrates are also sensitive to temperature and will move in the stream to find their optimal temperature. If temperatures are outside this optimal range for a prolonged period of time, organisms are stressed and can die.’ (EPA ref 1).

For fish there are two kinds of limiting temperatures, the maximum temperature for short exposures, and a weekly average temperature that varies according to the time of year and the life cycle stage of the fish species. Reproductive stages (spawning and embryo development) are the most sensitive stages.' (EPA ref 1) See table 1 for temperature criteria for salmonid fishes found in the Columbia River region.

Table 4. Lethal temperatures for selected salmonid species (Bjornn and Reiser 1991).

Species	Lower Lethal temp. ^oC	Upper Lethal temp. ^oC	Preferred Range ^oC
Coho Salmon	1.7	28.8	12-14
Chinook Salmon	0.8	26.2	12-14
Steelhead	0.0	23.9	10-13
Rainbow Trout	-	29.4	-
Cutthroat trout	0.6	22.8	-

Washington State Department of Ecology has set water quality standards for surface waters (WAC 173-201A). Limits have been set for temperatures, dissolved oxygen (DO),and turbidity in different class streams. Washington State has 4 classes ranging from Class AA (extraordinary), through Class C (fair). All the sites in this study are on federal land (US Forest Service) and are required to meet Class AA standards (table 5).

Table 5 Washington State surface water quality standards.

Class	Temperature *C shall not exceed	DO mg/L shall exceed	pH range shall be within
AA	16	9.5	6.5 - 8.5

'Temperature affects the oxygen content of the water (oxygen levels become lower as temperature increases); the rate of photosynthesis by aquatic plants; the metabolic rates of aquatic organisms; and the sensitivity of organisms to toxic wastes, parasites, and diseases.' (EPA ref 1) As temperature increases the organisms use up more oxygen as respiration increases while they adjust to cope with the rising temperature.

Factors affecting stream water temperatures include the weather, the amount of vegetation providing shade along the stream bank, groundwater inflows, the volume of water, the depth of the water, impoundments (barriers such as dams that restrict the flow), and the turbidity of the water. Wide shallow streams with slow flows are more likely to have increased temperatures as more of the water body is exposed to sunlight for a longer period of time compared to water in a narrow, deep channel with a rapid flow. 'Stream temperatures can be altered by removal of streambank vegetation, withdrawal and return of water for irrigation, release of water from deep reservoirs, and cooling of nuclear power plants.' (Bjornn and Reiser, 1991).

Manual temperatures were collected during the sampling period, while gathering general water chemistry data (pH, DO, etc.). This temperature data helps to monitor the effect water temperature may have on the other data. The data also gives us a snapshot in time of temperature information. For detailed temperature data continuous monitoring is required (see USGS 2002 annual report).

Table 6. Temperature data gathered during water chemistry sampling at each site, with maximum, minimum, mean, standard deviation and state maximum.

Water Temp*C					
Site	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
Rkm	27.29	32.54	31.46	32.03	33.15
29-Aug-02	14.8	13.5	14.8	5.8	13.6
25-Sep-02	10.5	10.1	9.8	5.1	9
30-Oct-02	3.6	3.3	5	4	2
12-Nov-02	6.9	6.3	6.4	5.8	7.1
18-Nov-02	6.5	6.1	6.1	5.6	6.5
25-Nov-02	4.9	4.4	4.2	4.7	3.8
18-Dec-02	4.4	4.2	4.2	4.7	5
29-Jan-03	4.3	4	4	4.5	4.6
25-Feb-03	3.6	2.1	2.8	3.7	2.5
4-Mar-03	4.7	3.6	3.7	4.3	3.8
11-Mar-03	4.9	4	4.2	4.7	4.7
18-Mar-03	5.1	4.4	4.3	4.6	4.6
25-Mar-03	5.2	4.5	4.6	4.7	4.9
29-Apr-03	7.9	6.1	6.5	5.3	6
27-May-03	9.5	7.7	8	4.8	7.1
23-Jun-03	9.5	8.2	9.1	4.8	8.3
Min	3.6	2.1	2.8	3.7	2
Max	14.8	13.5	14.8	5.8	13.6
Mean	6.6438	5.7813	6.1063	4.8188	5.8438
STDEV	3.0850	2.9098	3.0641	0.5913	2.8294
Class AA max	16.0	16.0	16.0	16.0	16.0

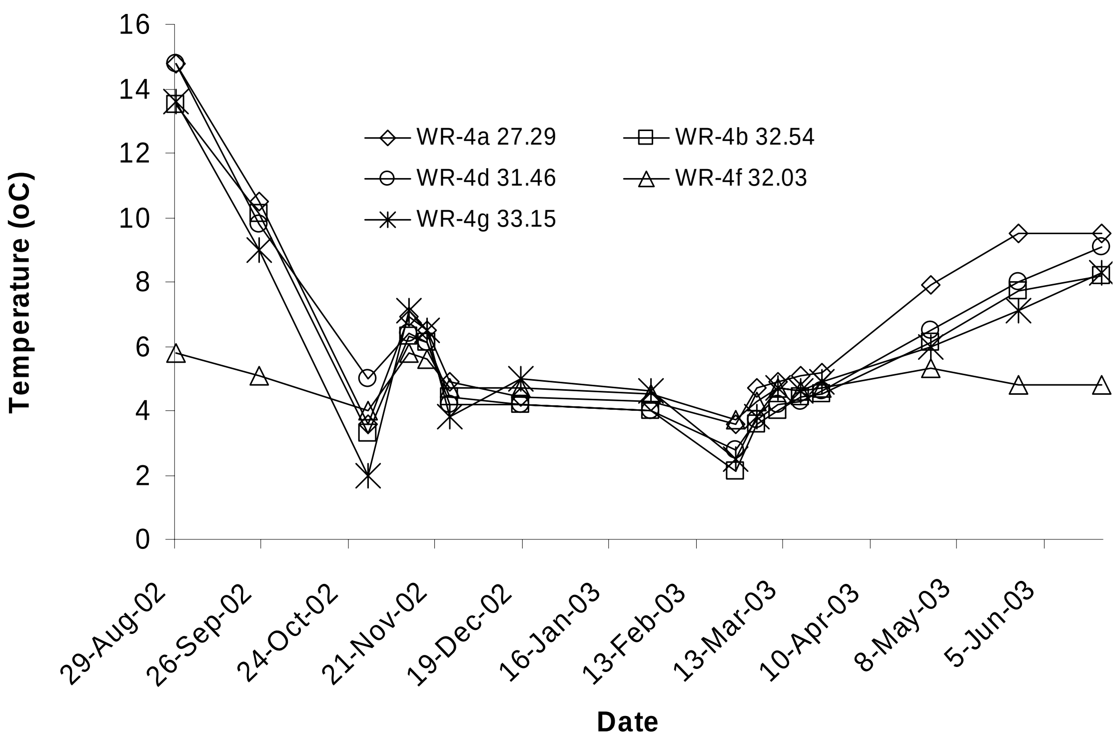

Figure 2. Water temperature data collected during the sampling period August 2002 to June 2003.

Temperature fluctuated seasonally. The highest temperatures were in August, and dropped sharply to October. The temperatures remained below 6^{o}C from October through March (except in November when there was a slight increase). From March the temperatures began to increase again, coinciding with warmer weather. The water temperatures correlated closely with air temperatures (figure 3).

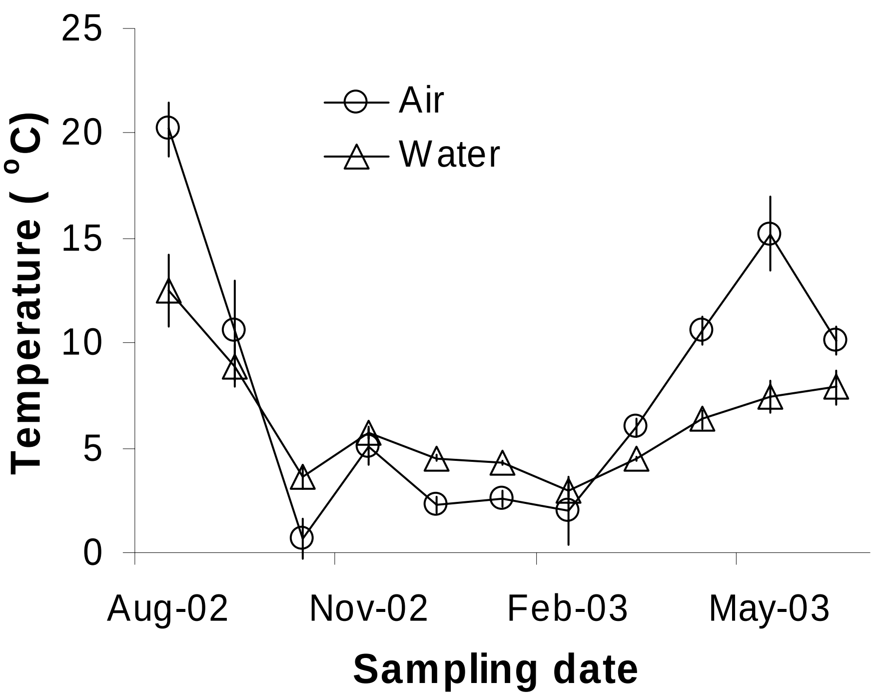

Figure 3. Mean air and water temperatures collected during water chemistry sampling, by sampling date 2002-2003.

Site 4f displayed consistently cool temperatures throughout the year (max 5.8^{o}C). Given this information, and the observation that the creek is considerably larger here than at 4g just a short distance up stream, it may be assumed that there is a considerable input from ground water to the system between the two sites. This is likely as there are no surface water inputs over the same reach.

The mean of all temperatures recorded at each site for the sample period (figure 3) indicate a slight increase downstream. Maximum temperatures recorded were 14.8^{o}C in August. While this is below the state maximum for Class AA streams it should be noted that the temperatures were recorded during the morning and early afternoon, and temperatures may still rise well into the afternoon. UCD and USGS also used continuous-reading temperature loggers (Onset® HOBOs® and Stowaways®) throughout the Wind River watershed to gather temperature data. Refer to the 2002 BPA report by USGS for the results.

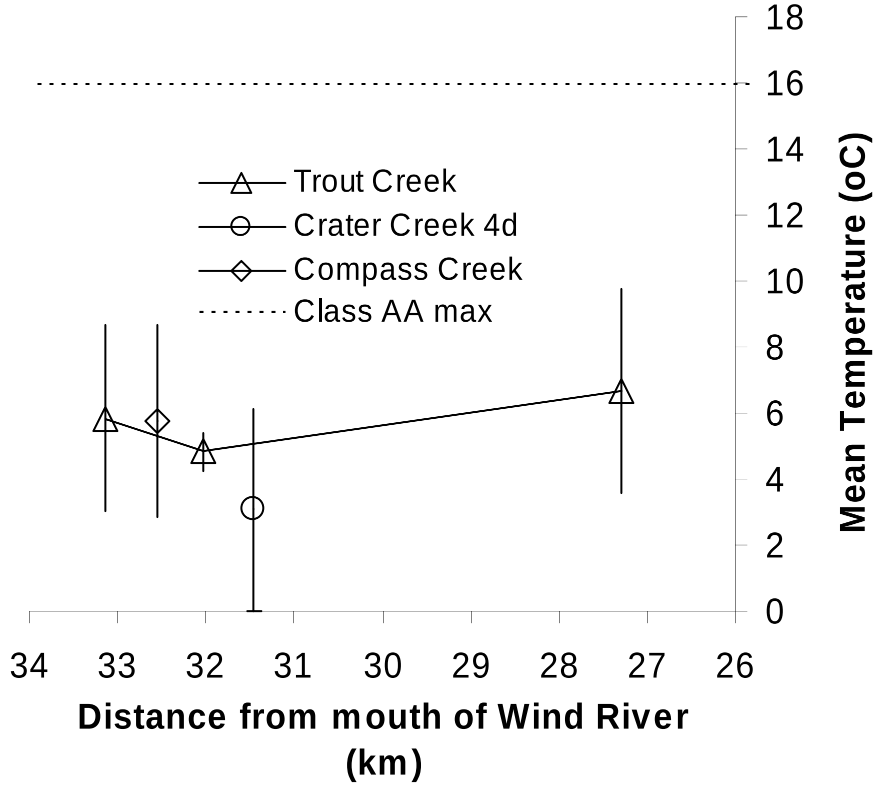

Figure 4. Mean water temperature recorded at sampling sites over the sampling period August 2003 to June 2003. Standard deviation is displayed as vertical bars.

Temperature Summary

Temperatures recorded were below the state maximum, but data from the continuous temperature loggers will be better suited to assessing this (refer to USGS 2002-2003 annual report for BPA). Overall the water temperatures followed seasonal fluctuations, and indicated a slight increase downstream.

pH

pH is a measure of how acidic or basic a water body is. The pH can directly affect the survival of aquatic organisms. Pure water is neutral, with a pH of 7. pH readings below 7 indicate acidic conditions. Waters with pH less than 4 generally have no vertebrate life forms in them. pH readings above pH7 indicate basic conditions. 'pH affects many chemical and biological processes in water. For example, different organisms flourish within different ranges of pH. The majority of aquatic organisms prefer a range of 6.5 – 8.0. pH outside this range reduces the diversity in the stream because it stresses the physiological systems of most organisms and can reduce reproduction. Low pH can also allow toxic elements and compounds to become mobile and "available" for uptake by aquatic plants and animals. This can produce conditions that are toxic to aquatic life, particularly to sensitive species like rainbow trout. Changes in acidity can be caused by atmospheric deposition (acid rain), surrounding rock, and certain wastewater discharges.' (EPA ref 2).

Table 7. pH levels for the sample period Aug 2002-June 2003, with maximum, minimum, mean, standard deviation and state required range.

pH Site Rkm	WR-4a 27.29	WR-4b 32.54	WR-4d 31.46	WR-4f 32.03	WR-4g 33.15
29-Aug-02	7.85	6.85	6.69	6.59	6.95
25-Sep-02	6.6	6.59	6.54	6.52	6.69
30-Oct-02	7.15	6.95	6.75	6.85	6.91
12-Nov-02	6.98	6.93	6.83	6.92	6.92
18-Nov-02	6.92	6.55	6.74	6.85	6.82
25-Nov-02	6.95	6.91	6.93	6.86	6.94
18-Dec-02	6.82	6.89	6.95	6.84	6.83
29-Jan-03	6.83	6.88	6.76	6.94	6.63
25-Feb-03	7.1	7.08	6.98	7.16	7.01
4-Mar-03	7.11	7.07	7.05	7.1	7.32
11-Mar-03	7.15	7.07	7.04	7.17	7.09
18-Mar-03	7.23	7.26	7.08	7.1	7.13
25-Mar-03	7.02	7.06	7.02	7.08	6.91
29-Apr-03	7.22	7.33	7.15	7.12	7.18
27-May-03	7.34	7.24	7.06	7	7.06
23-Jun-03	7.34	7.08	7.05	7.07	7.04
Min	6.6	6.55	6.54	6.52	6.63
Max	7.85	7.33	7.15	7.17	7.32
Mean	7.1006	6.9838	6.9138	6.9481	6.9644
STDEV	0.2818	0.2147	0.1737	0.1925	0.1766
Class AA min	6.5	6.5	6.5	6.5	6.5
Class AA max	8.5	8.5	8.5	8.5	8.5

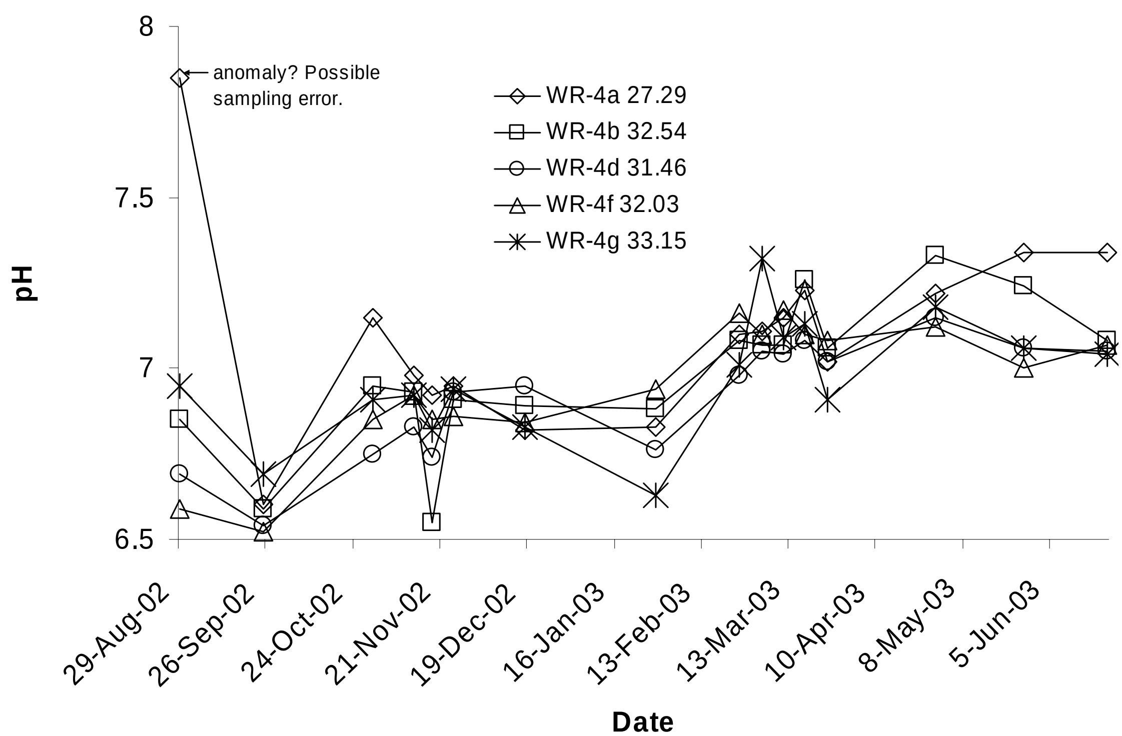

Figure 5. pH for each site displayed by date.

Figure 5 shows a general trend of increasing pH over the entire sampling period. It should be noted that it was a dry year, with unusually low snow fall in the winter. More data is needed to establish if this is a normal or abnormal trend. pH levels were fairly constant, ranging from pH 6.5 to 7.3 (Table 5 and figure 6). One reading at 4a in August was as high as pH 7.85. This is out of character with the other sites and the other sample dates. It may be due to a sampling error but the quality assurance data recorded does not indicate any problems with the meter or recording method. Future sampling will allow for better identification of fluctuations.

There are two sets of pH readings displayed in figures 7 and 8. One set was obtained using UCD equipment and the other obtained using a USGS meter (from November to April only). The two meters gave very similar readings which helps to confirm the quality of the data. In fig 7 the pH varies little compared to the fluctuations in the temperature over the sample period. In Fig 8 the pH scale is displayed in more detail, and shows how the two meters performed against each other. It also highlights the low readings gathered in September, which are considerably different to the rest of the year. August also displays a larger standard deviation than observed on the other dates (due to the high reading at 4a). Figure 6 indicates mean pH levels increase slightly downstream.

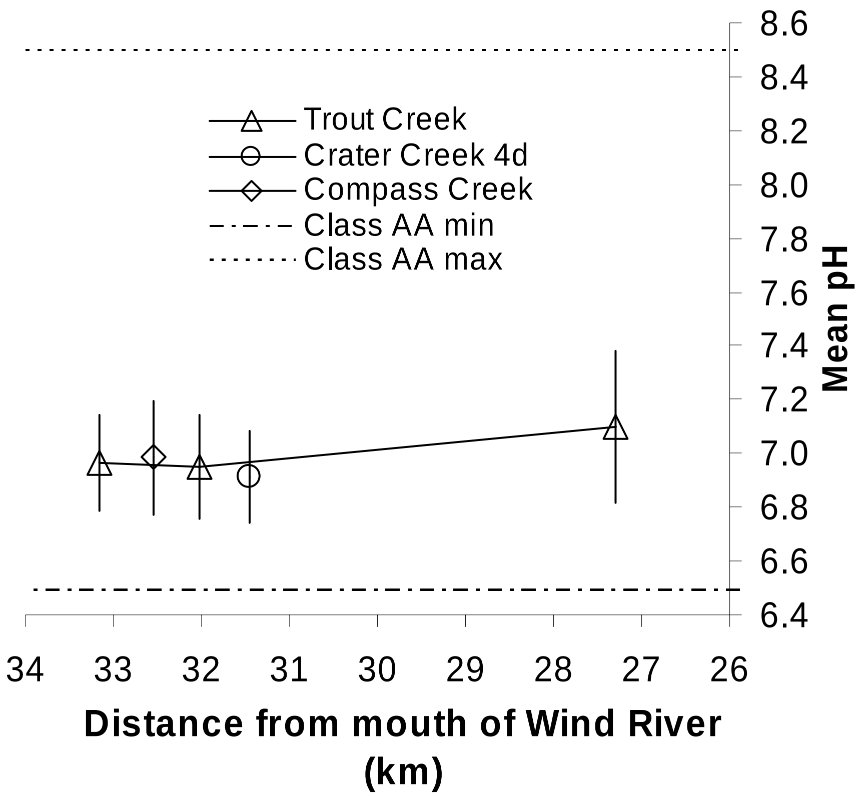

Figure 6. Mean pH levels recorded from August 2002 to June 2003 in Trout Creek, displayed by km. Standard deviation is expressed as vertical bars.

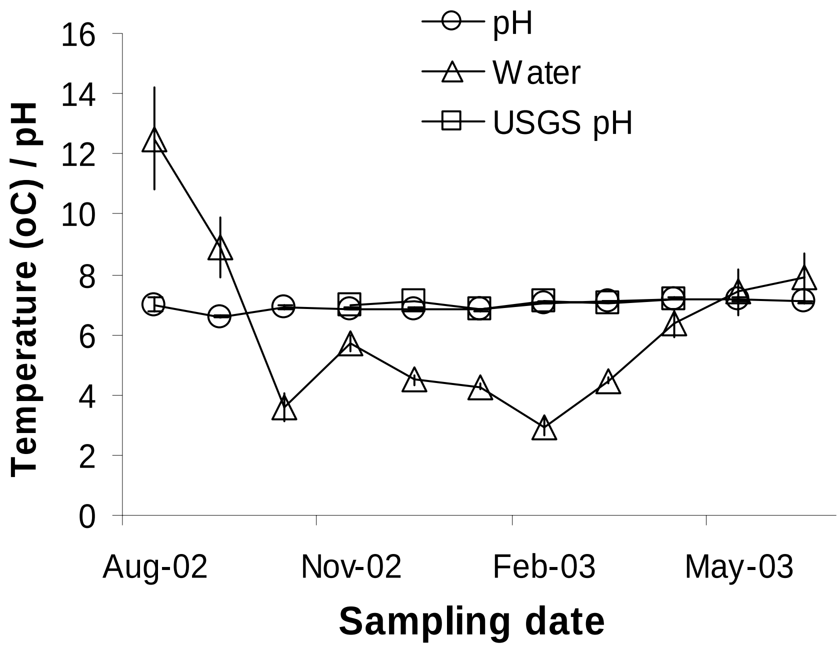

Figure 7. Mean pH and temperature readings by sampling date. Standard deviation displayed as vertical bars.

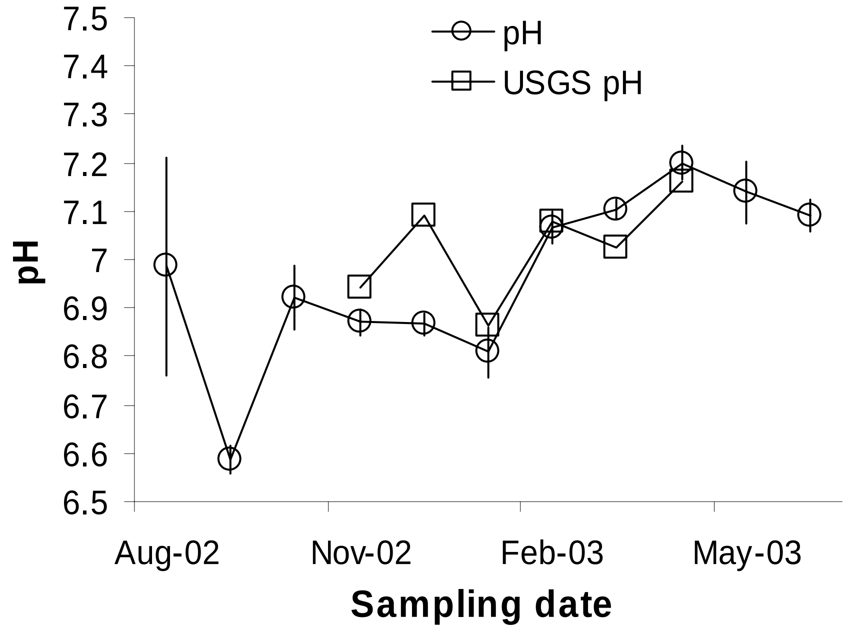

Figure 8. Mean pH readings of all 5 sites displayed by sample date. Standard deviations are displayed as vertical bars.

pH Summary

There is a general trend of increasing pH downstream, and over the entire sampling period August 2002 through June 2003. It should be noted that 2002-2003 was a year of low snowfall, which may have affected results. Data collection will continue for a second year in order to get a better picture of pH levels in the Trout Creek system.

Dissolved Oxygen

Dissolved oxygen (DO) is a measure of the amount of oxygen dissolved in water. It is important for determining whether the water body can support organisms which require oxygen – aerobic organisms – such as fish and zooplankton. High dissolved oxygen levels are better. Generally, levels of 5-6 mg/L can support diverse forms of aquatic life (USGS ref1).

DO is both produced and consumed in the stream system. Oxygen is acquired from the atmosphere and from plants as a result of photosynthesis. Running water dissolves more oxygen than still water as the turbulence at the water surface traps more air. Aquatic animal respiration, decomposition, and various chemical reactions consume oxygen. 'Oxygen is measured in its dissolved form as DO. If more oxygen is consumed than is produced, DO levels decline and some sensitive animals may move away, weaken, or die.' (EPA ref 3).

'DO levels fluctuate seasonally and over a 24-hour period. They vary with water temperature and altitude. Cold water holds more oxygen than warm water and water holds less oxygen at higher altitude. Aquatic animals are most vulnerable to lowered DO levels in the early morning on hot summer days when stream flows are low. Water temperatures are high, and aquatic plants have not been producing oxygen since sunset.' (EPA ref 3).

Table 8. DO levels with minimum, maximum, mean, standard deviation, and the state minimum requirement for the creeks on federal land. (DO not reported for 4a on 12 Nov, due to recording error)

DO mg/L Site Rkm	WR-4a 27.29	WR-4b 32.54	WR-4d 31.46	WR-4f 32.03	WR-4g 33.15
29-Aug-02	8.96	7.8	7.59	10.5	8.39
25-Sep-02	11.36	9.22	10.65	12.25	10.51
30-Oct-02	12.86	11.54	9.84	12.4	12.75
12-Nov-02		11.48	11.49	11.84	11.43
18-Nov-02	11.86	11.77	11.77	12.17	11.75
25-Nov-02	12.13	12.15	12.43	12.42	12.61
18-Dec-02	11.18	12.33	12.44	12.57	11.18
29-Jan-03	10.25	12.04	12.17	12.24	12.58
25-Feb-03	12.67	13.14	12.82	12.51	13.21
4-Mar-03	12.23	12.24	12.56	12.34	12.97
11-Mar-03	12.21	12.55	12.63	12.55	13.26
18-Mar-03	12.19	12.54	12.7	12.71	12.5
25-Mar-03	12	12.35	12.56	12.54	13.65
29-Apr-03	11.86	12.06	12.04	12.3	12.13
27-May-03	11.84	11.43	11.33	12.13	11.45
23-Jun-03	11.84	10.94	10.69	11.27	11.21
Min	8.96	7.8	7.59	10.5	8.39
Max	12.86	13.14	12.82	12.71	13.65
Mean	11.6960	11.5988	11.6069	12.1713	11.9738
STDEV	0.9794	1.3413	1.3793	0.5616	1.3033
Class AA min.	9.5	9.5	9.5	9.5	9.5

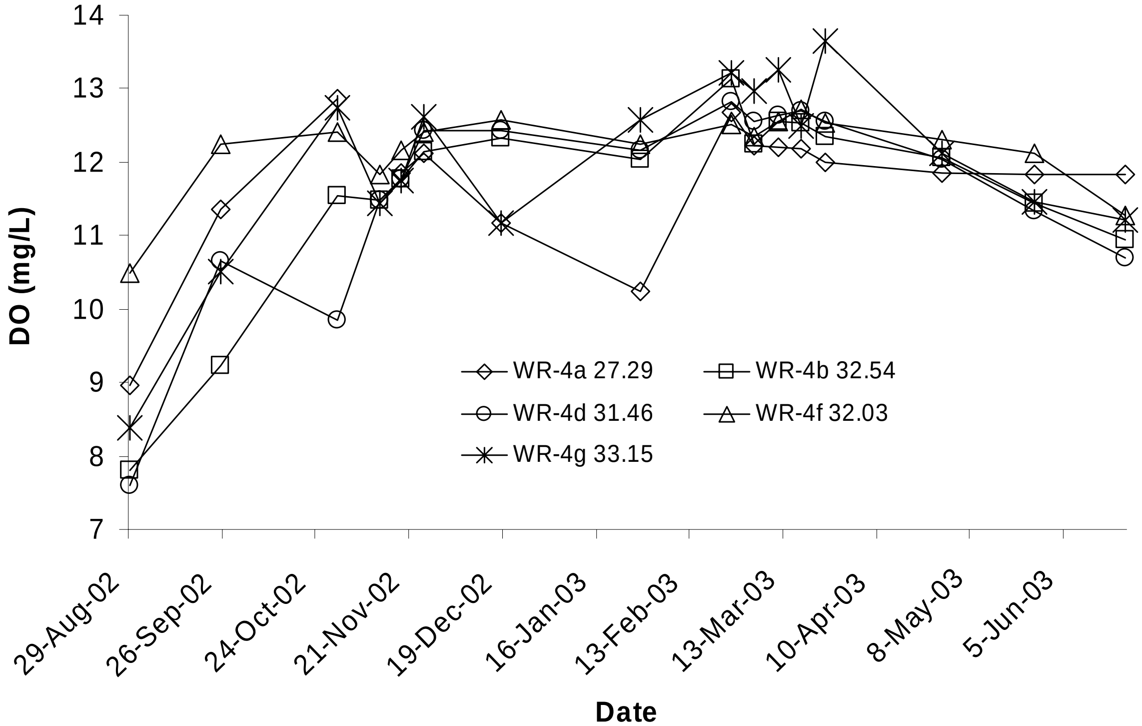

Figure 9. DO levels for each site over the sampling period.

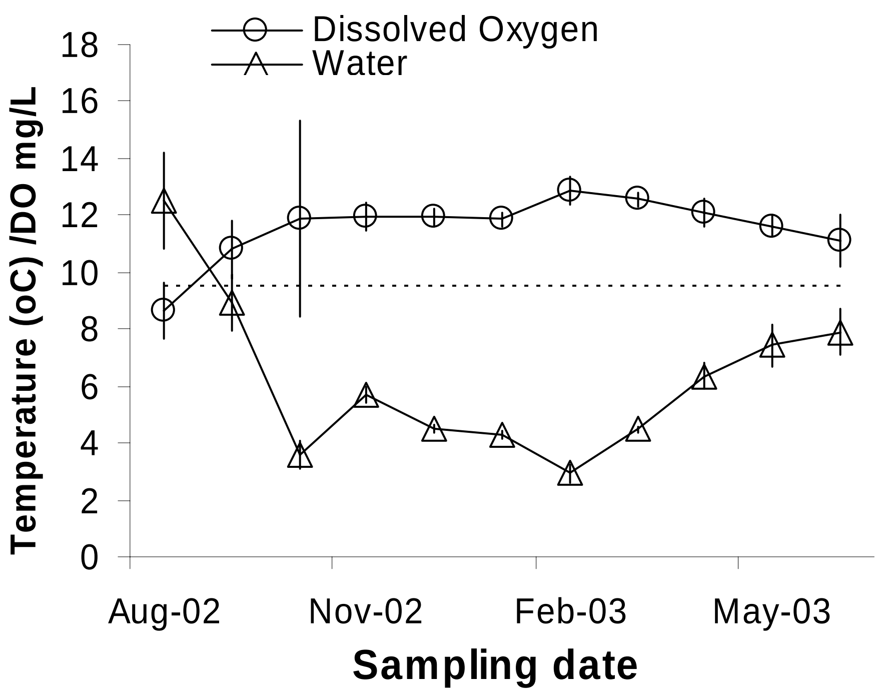

Figure 10 Mean DO for all sites for each month. (Note that November includes 3 sets of data (15 data points) and March includes 4 sets of data (20 samples))

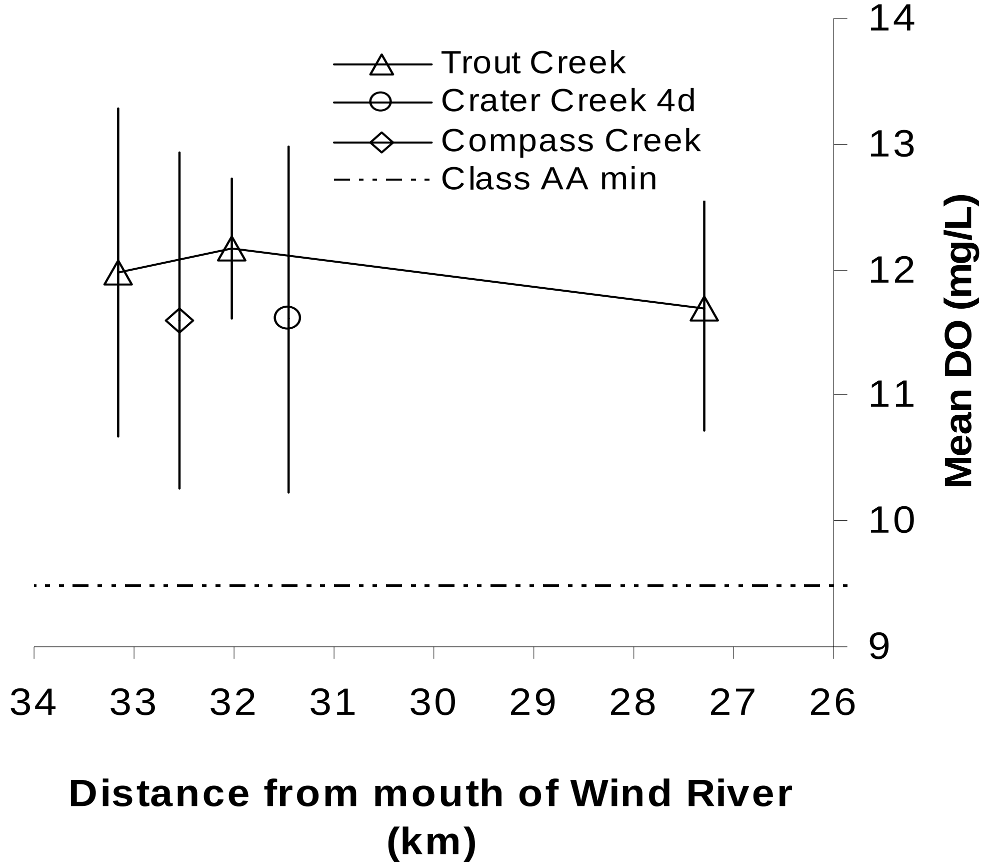

Figure 11. Mean Dissolved Oxygen Levels in Trout Creek, 2002-2003, with standard deviation displayed as vertical bars.

Trout Creek at site 4f (km 32.03) has higher DO on average throughout the year compared to the other sites (figure 10 and table 6), and varies the least. This correlates with the temperatures recorded at the time of sampling (fig 10). Site 4f is consistently cooler and temperature fluctuates little over the year. The general trend in fig 11 indicates a decrease in DO downstream. It also indicates that the two tributaries, Compass Creek and Crater Creek, have slightly lower average DO compared to Trout Creek.

DO remains fairly constant but there are slight variations that appear to correlate with changes in temperature, which would be expected. August 2002 shows all but site 4f, were below the state Class AA minimum. This also coincides with the highest temperatures recorded for all the sites. 4b (Crater Creek) was also below the state standard in September. Site 4f has consistently cool temperatures which helps DO remain fairly constant and above the state minimum.

DO Summary

DO was below state standards in August of 2002, but increased with decreasing temperatures. 4f was consistently cool and as such displayed consistent DO levels above state standards.

Turbidity

Turbidity is a measure of the clarity of the water. The amount of debris, soil particles, or plankton in the water affects the amount of sunlight that reaches aquatic plants. High turbidity will reduce the amount of light passing through the water column and reduce the plant's ability for photosynthesis, and so reduce the amount of available oxygen in the water. Excess silt and detritus in the water can also smother spawning areas, covering eggs with silt so they cannot breathe.

'Higher turbidity increases water temperatures because suspended particles absorb more heat. This in turn, reduces the concentration of dissolves oxygen (DO) because warm water holds less DO than cold.' (EPA ref 4). 'Suspended materials can clog fish gills, reducing resistance to disease in fish, lowering growth rates, and affecting egg and larval development. As the particles settle, they can blanket the stream bottom, especially in slower waters, and smother fish eggs and benthic macroinvertebrates. Sources of turbidity include; soil erosion, waste discharge, urban runoff, eroding stream banks, and excessive algal growth.

Regular monitoring of turbidity can help detect trends that might indicate increasing erosion in developing watersheds. However, turbidity is closely related to stream flow and velocity and should be correlated with these factors. Comparisons of the change in turbidity over time, therefore should be made at the same point at the same flow. Turbidity is not a measurement of the amount of suspended solids present or the rate of sedimentation of a stream since it measures only the amount of light that is scattered by suspended particles.' (EPA ref 4).

Table 9. Turbidity data for the sample period August 2002-June 2003. (No turbidity data exists for May and June as the meter was out of service).

Turbidity Site Rkm	WR-4a 27.29	WR-4b 32.54	WR-4d 31.46	WR-4f 32.03	WR-4g 33.15
29-Aug-02	0.24	0.9	0.63	1.97	1.64
25-Sep-02	0.29	0.25	0.69	0.51	0.64
30-Oct-02	0.26	0.37	0.27	0.41	2.82
12-Nov-02	2.32	0.76	0.67	1.41	0.96
18-Nov-02	0.57	0.42	0.27	0.29	0.36
25-Nov-02	0.28	0.24	0.28	0.24	0.6
18-Dec-02	0.76	0.54	0.36	1.08	0.76
29-Jan-03	1.85	0.64	0.66	0.46	0.66
25-Feb-03	0.65	0.46	0.36	0.37	0.41
4-Mar-03	0.54	0.27	0.33	0.29	0.5
11-Mar-03	1	0.41	0.35	0.34	0.45
18-Mar-03	0.7	0.37	0.33	0.43	0.47
25-Mar-03	1.19	0.57	0.58	0.55	0.51
29-Apr-03	0.51	0.25	0.39	0.3	0.51
27-May-03					
23-Jun-03					
Min	0.24	0.24	0.27	0.24	0.36
Max	2.32	0.9	0.69	1.97	2.82
Mean	0.7971	0.4607	0.4407	0.6179	0.8064
STDEV	0.6189	0.2014	0.1642	0.5104	0.6641

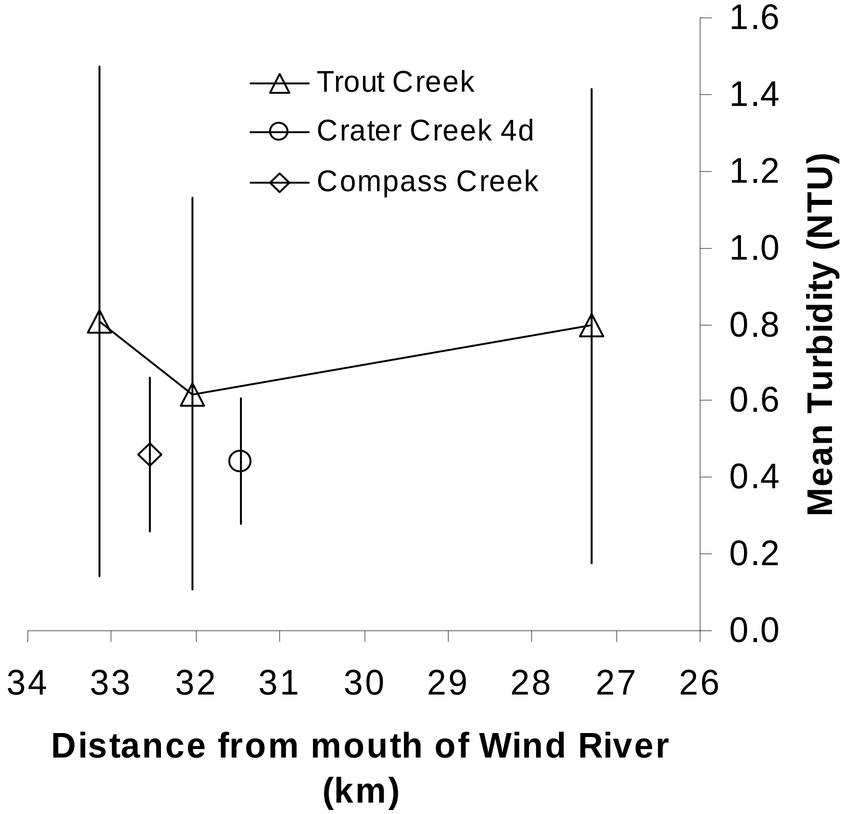

Figure 12. Mean Turbidity in Trout Creek Basin, 2002-2003 with standard deviation displayed as vertical bars. Based on 14 data points collected at each site.

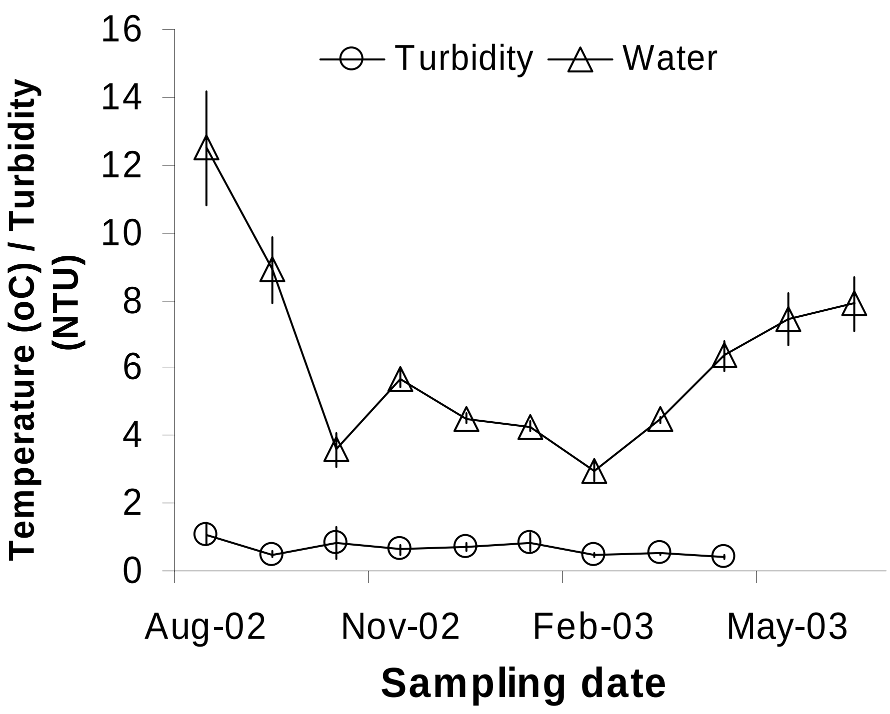

Figure 13. Mean turbidity by sample dates, coordinated with mean temperatures. Samples for turbidity were not taken in May and June as the meter was out of service.

There is little correlation between turbidity and temperature (figure 13). Turbidity levels were consistently low on all the dates sampled. Increased sampling will allow a better determination of the normal/background turbidity levels for the creeks. The highest reading was 2.82 NTU in October. February March and April showed the lowest mean turbidity levels (table 9 and figure 14), and the least variation between sites.

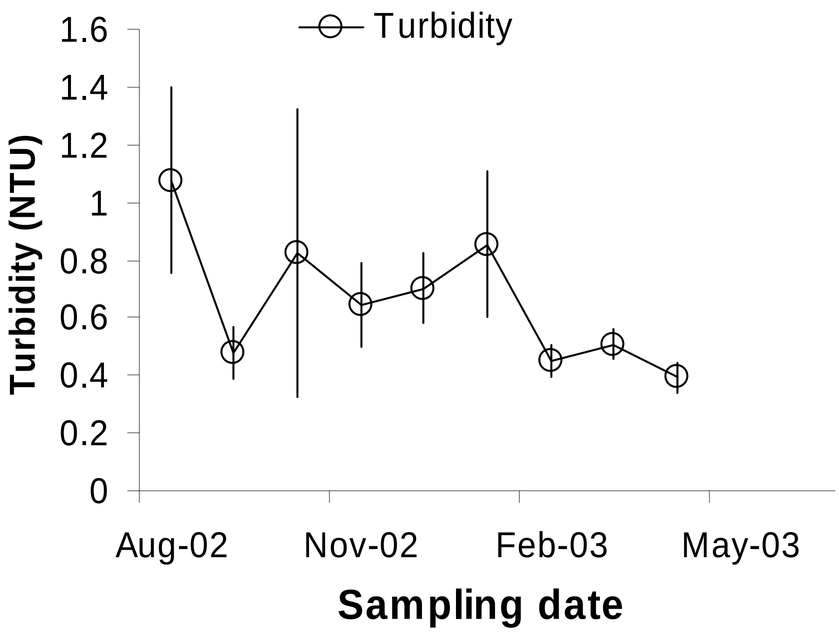

Figure 14 Mean turbidity over of all sites over the sampling period August 2002 to June 2003.

Turbidity Summary

Turbidity levels were consistently low and decreased slightly over the sampling period August 2002 to April 2003. The lowest levels were recorded February through March. The tributaries, Crater Creek and Compass Creek had generally lower turbidity levels than Trout Creek.

Conductivity

'Conductivity is a measure of the ability of water to pass an electrical current. Conductivity in water is affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate anions. (ions that carry a negative charge) or sodium, magnesium, calcium, iron, and aluminum cations (ions that carry a positive charge). Organic compounds like oil, phenol, alcohol, and sugar do not conduct electrical current very well and therefore have low conductivity when in water. Conductivity is also affected by temperature; the warmer the water, the higher the conductivity. For this reason, conductivity is reported at 25 degrees Celsius (25C). Conductivity in streams and rivers is affected primarily by the geology of the area through which the water flows. Streams than run through areas with clay soils tend to have higher conductivity because of the presence of materials that ionize when washed into the water. Ground water inflows can have the same effects depending on the bedrock they flow through.

The conductivity of rivers in the United States generally ranges from 50 to 1500 us/cm. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 ms/cm. Conductivity outside this range could indicate that the water is not suitable for certain species of fish of macroinvertebrates.' (EPA ref 5)

Conductivity is useful as a general measure of stream water quality. Each stream tends to have a relatively constant range of conductivity that, once established, may be used as a baseline for comparison with regular conductivity measurements. Significant changes in conductivity could then be an indicator that a discharge or some other source of pollution has entered a stream (EPA ref. 5).

Table 10. Conductivity levels for the sample period August 2002 to June 2003, with Minimum, maximum, mean, and standard deviation.

Conductivity us/cm					
Site	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
Rkm	27.29	32.54	31.46	32.03	33.15
29-Aug-02	29.1	36.1	34	27.2	33.4
25-Sep-02	30.7	39.3	36	28.5	35.3
30-Oct-02	31.3	36.8	38.7	28.3	34.8
12-Nov-02	31.2	31.4	30.7	29.6	32.9
18-Nov-02	28	27	26	28	31.9
25-Nov-02	27.4	28	25	25.6	31.7
18-Dec-02	21.5	21.9	18.4	20.4	21.5
29-Jan-03	19.7	21.4	17.8	19.3	20.2
25-Feb-03	21.1	21.7	18.3	20.7	22.6
4-Mar-03	20.1	23.9	20.3	21.4	24
11-Mar-03	21.4	21.2	18.96	22.3	23.8
18-Mar-03	22.1	23.3	19.14	20.9	22.5
25-Mar-03	21	22.2	18.17	19.74	20.8
29-Apr-03	24.8	26	22.1	22.9	26.2
27-May-03	27.2	26.7	25	24.1	28.1
23-Jun-03	27.2	32.2	29.3	25.3	31.1
Min	19.7	21.2	17.8	19.3	20.2
Max	31.3	39.3	38.7	29.6	35.3
Mean	25.2375	27.4438	24.8669	24.015	27.55
STDEV	4.22641	6.00511	6.97446	3.51335	5.4111

This data will help establish the background conditions in the creeks. Compass Creek shows the largest variation, and Crater Creek has the highest reading, but all the sites appear to increase and decrease simultaneously over the sample period (figure 15). The lowest readings were during the winter months when flows were higher. This may be an effect of increased volume of water decreasing the concentration of ions in the water. Mean conductivity for each site over the entire sampling period (figure 16) indicates a slight decrease downstream.

Conductivity Summary

Based on the data collected, conductivity ranges from the high teens to low 30s. Dramatic increases or decreases were not observed. In general conductivity was higher during low flow periods, (possibly due to increased concentration with less water volume).

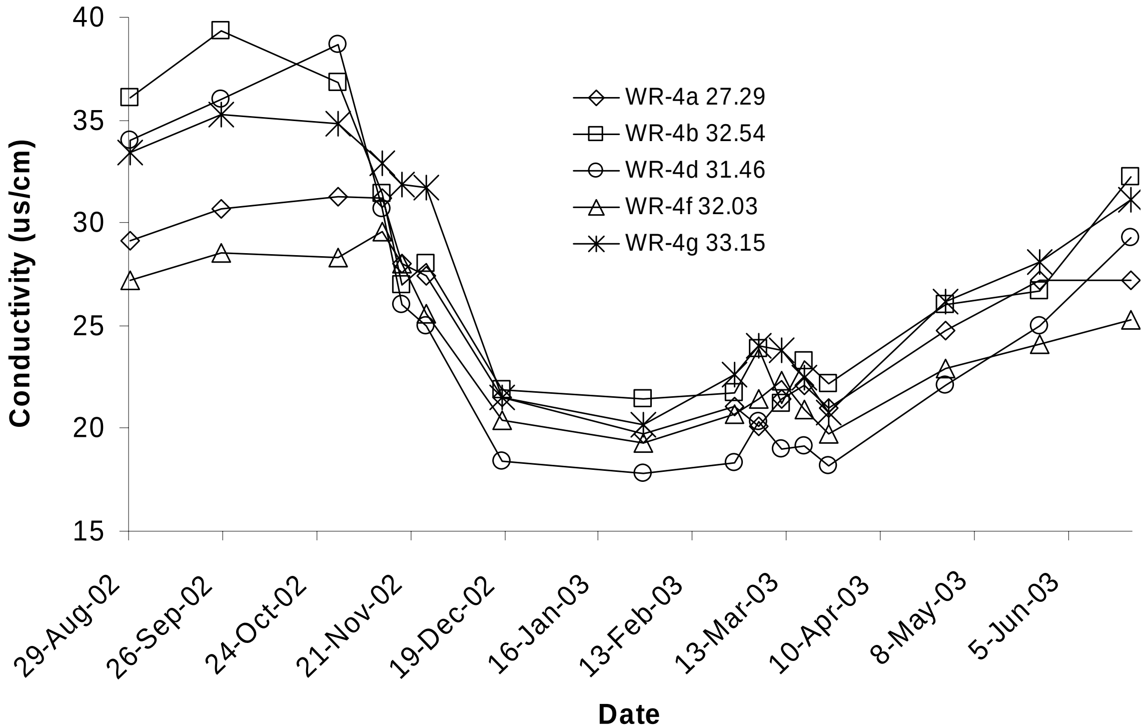

Figure 15. Conductivity for each site over the sample period.

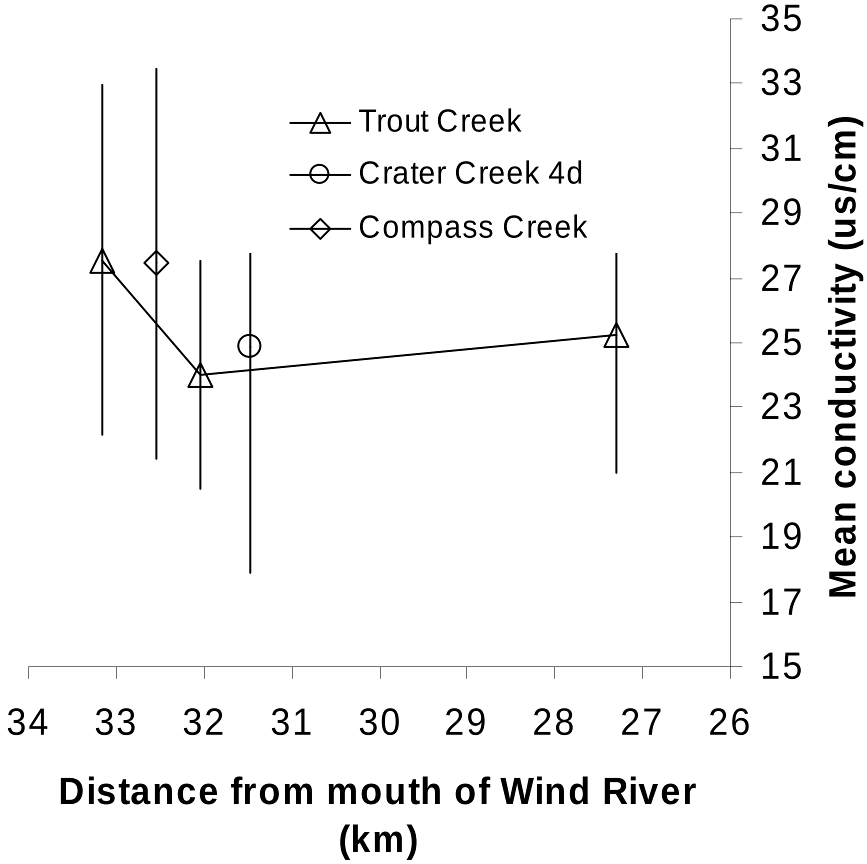

Figure 16. Mean conductivity of all sites by sample date from August 2002 to June 2003.

Advanced Chemical Analysis

Samples were collected in laboratory prepared sample bottles for Alkalinity, Total suspended solid. Sulfate, tannins and lignins. The samples were sent to an EPA certified laboratory who analyzed the samples using EPA methodologies.

Columbia Analytical Services
1317 South 13th Avenue
Kelso WA.

Total Suspended Solids

Total suspended solids (TSS) is an assessment of the amount of solid material suspended in the water column. Suspended solids include silt, clay, plankton, algae, organic debris, and other particulate matter. High concentrations act as carriers for toxins. As with turbidity, suspended sediments can affect fish habitat by increasing water temperatures and reduction of dissolved oxygen from reduced photosynthesis.

Sampling in Trout Creek almost always resulted in no detection of TSS, the water was very clear. With the EPA TSS testing method 160.2 the reporting level was 5mg/L, only 6 out of the 64 samples were above this reporting level, and each of those readings were low (5, 6, or 7mg/L).

TSS Summary

Based on the data collected, TSS levels were very low, (below the tests reporting/detection limit). Although it appears that the readings are non existent, this is still 'good data' as it is contributing to the establishment of normal / background levels (normally below 5mg/L). Further sampling during a year with normal snow pack and less droughty winter and summer, will continue to establish a baseline of information on which to assess future management.

Table 11. Total Suspended Solid (TSS) levels for the sample period August 2002-June 2003.

TSS mg/L					
Site	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
Rkm	27.29	32.54	31.46	32.03	33.15
29-Aug-02	<5.0	<5.0	<5.0	<5.0	<5.0
25-Sep-02	<5.0	<5.0	<5.0	<5.0	<5.0
30-Oct-02	<5.0	<5.0	<5.0	<5.0	<5.0
12-Nov-02	<5.0	<5.0	<5.0	<5.0	<5.0
18-Nov-02	<5.0	<5.0	<5.0	<5.0	<5.0
25-Nov-02	<5.0	<5.0	<5.0	<5.0	<5.0
18-Dec-02	<5.0	<5.0	<5.0	<5.0	<5.0
29-Jan-03	<5.0	<5.0	<5.0	<5.0	<5.0
25-Feb-03	<5.0	<5.0	<5.0	<5.0	<5.0
4-Mar-03	<5.0	<5.0	<5.0	**6**	<5.0
11-Mar-03	<5.0	<5.0	<5.0	<5.0	**6**
18-Mar-03	<5.0	<5.0	<5.0	<5.0	<5.0
25-Mar-03	<5.0	<5.0	<5.0	<5.0	<5.0
29-Apr-03	<5.0	<5.0	<5.0	**5**	<5.0
27-May-03	<5.0	<5.0	**6**	<5.0	<5.0
23-Jun-03	<5.0	<5.0	**7**	<5.0	**7**
Min Detected	<5.0	<5.0	6	5	6
Max	<5.0	<5.0	7	6	7
Mean	#DIV/0!	#DIV/0!	6.5000	5.5000	6.5000
STDEV	#DIV/0!	#DIV/0!	0.7071	0.7071	0.7071
Method Reporting Limit	5.0	5.0	5.0	5.0	5.0

Alkalinity

Alkalinity is a measure of the capacity of water to neutralize acids (see pH description). Alkaline compounds in the water such as bicarbonates (baking soda is one type), carbonates, and hydroxides remove H+ ions and lower the acidity of the water (which means increased pH). They usually do this by combining with the H+ ions to make new compounds. Without this acid-neutralizing capacity, any acid added to a stream would cause an immediate change in the pH. Measuring alkalinity is important in determining a stream's ability to neutralize acidic pollution from rainfall or wastewater. It's one of the best measures of the sensitivity of the stream to acid inputs.

Alkalinity in streams is influenced by rocks and soils, salts, certain plant activities, and certain industrial wastewater discharges. For fish, alkalinity can be important in maintaining the acidic level of streams in an acceptable range.

Total alkalinity is assessed by measuring the amount of acid (e.g., sulfuric acid) needed to bring the sample to a pH of 4.2. At this pH all the alkaline compounds in the sample are "used up." The result is reported as milligrams per liter of calcium carbonate (mg/L $CaCO_3$).

Table 12. Alkalinity levels for each site with minimum, maximum, mean, standard deviation and method reporting limit.

Alkalinity as CaCo3 mg/L					
Site	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
Rkm	27.29	32.54	31.46	32.03	33.15
29-Aug-02	11	11	13	11	16
25-Sep-02	13	12	14	11	17
30-Oct-02	13	30	12	12	16
12-Nov-02	12	13	12	13	16
18-Nov-02	11	12	10	8	13
25-Nov-02	10	12	10	11	11
18-Dec-02	8	8	7	8	9
29-Jan-03	9	9	8	8	9
25-Feb-03	9	9	7	8	10
4-Mar-03	10	10	9	9	10
11-Mar-03	8	8	8	8	9
18-Mar-03	8	8	7	8	9
25-Mar-03	9	10	7	7	10
29-Apr-03	12	12	10	11	13
27-May-03	13	13	12	12	14
23-Jun-03	10	11	11	10	15
Min	8	8	7	7	9
Max	13	30	14	13	17
Mean	10.375	11.75	9.8125	9.6875	12.3125
STDEV	1.82117	5.17043	2.34432	1.88746	3.004857
Method Reporting Limit	2	2	2	2	2

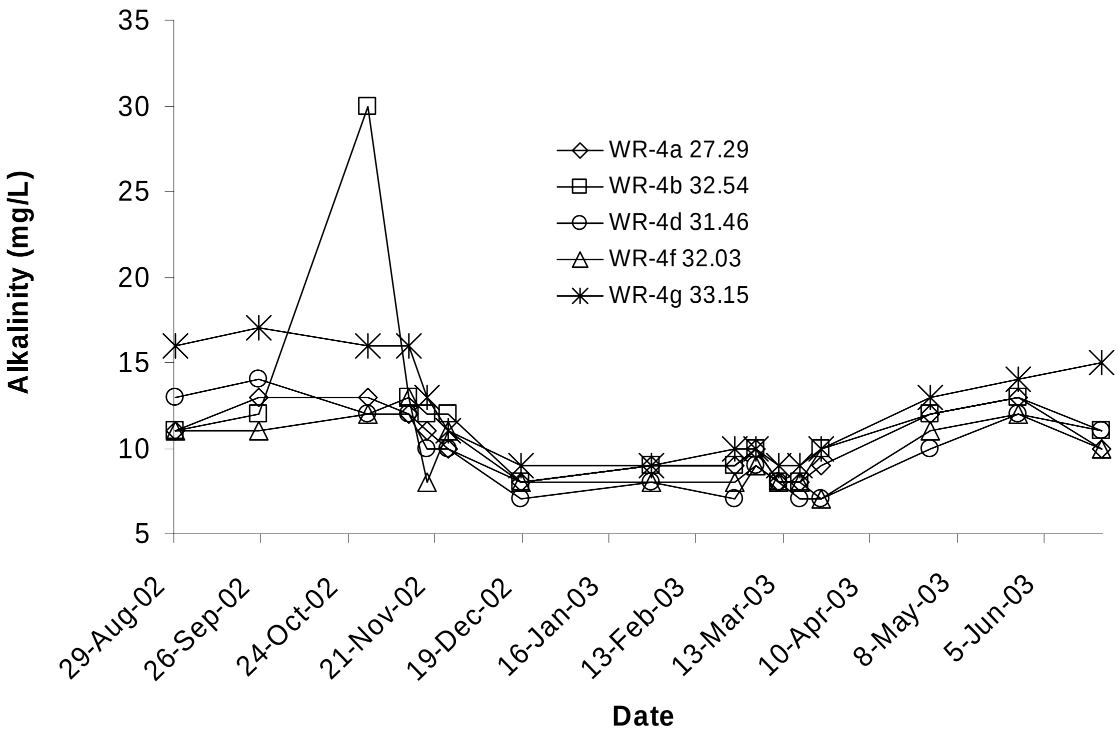

Figure 17 Alkalinity level for each site, August 2002 to June 2003.

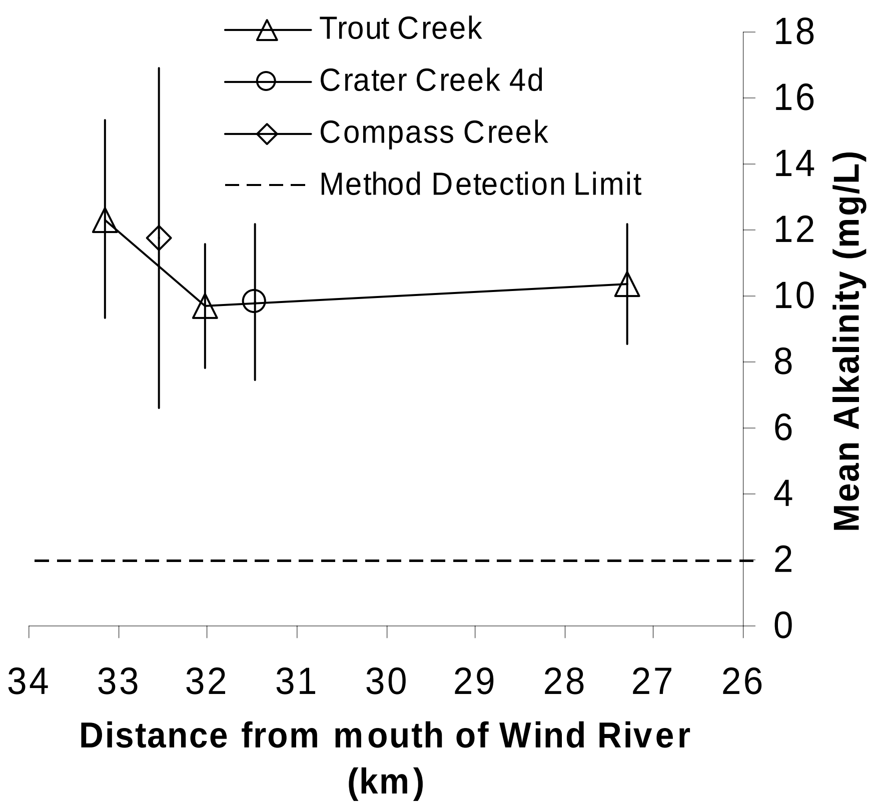

Figure 18. Mean alkalinity (CaCO3) by site for the sampling period August 2002-June 2003. Standard deviation displayed as vertical bars.

Trout Creek samples show fairly stable levels of CaCO3. The lowest levels appear in the winter and increase as flows decrease in to the summer. Compass Creek (4b) has the highest reading (30 mg/L) in October 2002. This is unusually high compared to the rest of the sites on that date, and even compared to previous and subsequent readings at the same site.

Alkalinity Summary

Overall alkalinity fluctuated gradually, and coincided with seasonal changes in temperatures and flow.

Sulfate

Sulfate is a measure of the acid in water. Sulfates enter streams from acid rain, rocks and soils, and from plant materials. Coniferous plants are often acidic and produce acidic soils. Precipitation falling onto acidic detritus and soils will pick up some of the acidity. It was speculated that the snow pack may contribute to increased acidity into Trout Creek. Snow may fall as an acidic precipitation, and /or pick up acid from the soils and plants on which it settles. The slow melting of snow allows the water to remain on acidic surfaces longer than a rain storm might, and so have a better chance of absorbing acids. Samples were analyzed using EPA method 300.0, with a method reporting limit of 0.2mg/L.

Table 13. Sulfate levels recorded for the sample period August 2002 to June 2003, with minimum, maximum, mean, standard deviation and method reporting limit.

Sulfate SO4					
Site	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
Rkm	27.29	32.54	31.46	32.03	33.15
29-Aug-02	1.1	1.1	1.5	1	0.4
25-Sep-02	1.2	1.2	1.8	1.2	0.4
30-Oct-02	1.1	0.9	1.8	1.1	0.3
12-Nov-02	0.9	0.8	1.3	0.9	0.4
18-Nov-02	0.7	0.7	0.8	0.9	0.4
25-Nov-02	0.8	0.7	0.9	1	0.4
18-Dec-02	0.5	0.6	0.6	0.6	0.4
29-Jan-03	0.5	0.6	0.5	0.5	0.3
25-Feb-03	0.6	0.7	0.7	0.6	0.5
4-Mar-03	0.6	0.7	0.8	0.6	0.4
11-Mar-03	0.6	0.7	0.7	0.6	0.5
18-Mar-03	0.6	0.6	0.6	0.6	0.4
25-Mar-03	0.6	0.7	0.7	0.6	0.5
29-Apr-03	0.7	0.8	0.7	0.7	0.5
27-May-03	0.6	0.7	0.7	0.6	0.3
23-Jun-03	0.7	0.9	1	0.7	0.3
Min	0.5	0.6	0.5	0.5	0.3
Max	1.2	1.2	1.8	1.2	0.5
Mean	0.7375	0.7750	0.9438	0.7625	0.4000
STDEV	0.2217	0.1732	0.4226	0.2187	0.0730
Method Reporting Limit	0.2	0.2	0.2	0.2	0.2

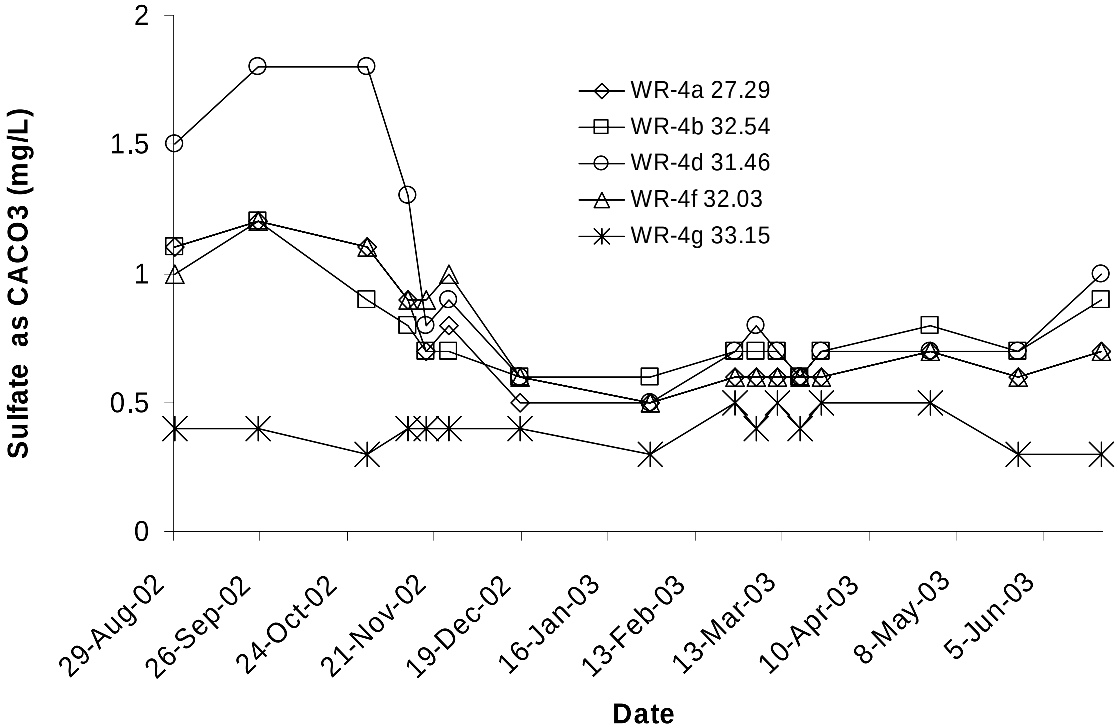

figure 19. Sulfate levels for each site from August 2002 to June 2003.

Based on the data collected, the sulfate levels decrease over the sample period. The lowest levels were in the winter when flows were highest. The highest sulfate levels were in September and October. In particular, Compass Creek had the highest readings from August through November, and fluctuated the most (0.5-1.8mg/L). Upper Trout Creek at site 4g consistently displayed the lowest levels throughout the year, and fluctuated very little (0.3-0.5mg/L). The higher sulfate readings in the late summer of 2002 may have been due to increased temperatures and low flows causing sulfate to be in higher concentration. It appears to begin to increase again heading in to June. Sulfate appeared to increase downstream on Trout Creek, the two tributaries, Compass Creek and Crater Creek displayed higher average readings than Trout Creek (figure 20).

Since 2002-2003 was a dry winter with relatively little runoff from snowmelt, we may see a different picture in our 2003-2004 sampling.

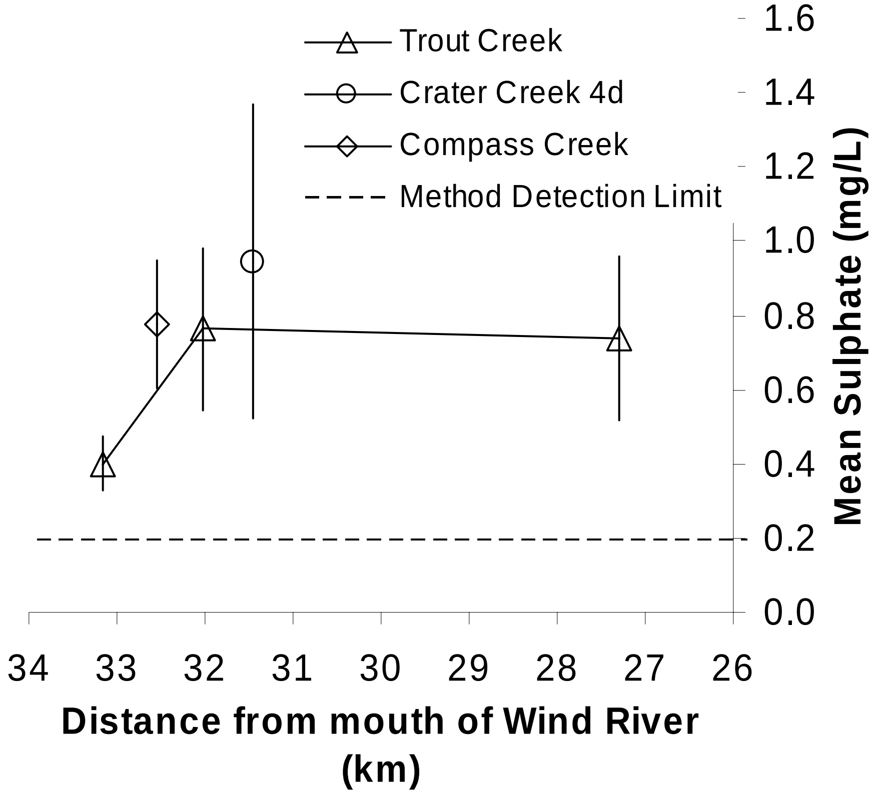

Figure 20. Mean sulfate levels at each site for the sample period Aug 2002-June 2003. Standard deviation displayed as vertical bars.

Sulfate Summary

Sulfate was highest in the late summer, and appears to fluctuate seasonally being lower in winter when flows are higher (possibly diluting sulfate levels). The trend appears to coincide with the lowest pH readings also in late summer. pH increased as sulfate decreased through the winter. Sulfate levels increased slightly downstream.

Tannins and Lignins

Tannins and lignins can enter the stream system from decaying plant material. They can contribute to the acidity of water, lowering the pH. Sampling for tannins and lignins may help identify a source if the waters are found to be acidic.

Samples were taken only a few times during the sample period due to the high cost of the analysis. Columbia Analytical Services used Standard Method SM 5550 B with a method reporting limit of 0.2mg/L.

Table 14. Tannin and lignin levels recorded during the sampling period August 2002-June 2003.

Tannins-Lignins mg/L					
Site	WR-4a	WR-4b	WR-4d	WR-4f	WR-4g
Rkm	27.29	32.54	31.46	32.03	33.15
29-Aug-02	<0.2	<0.2	0.2	<0.2	0.2
25-Sep-02					
30-Oct-02					
12-Nov-02					
18-Nov-02	0.4	0.3	0.4	<0.2	0.3
25-Nov-02					
18-Dec-02					
29-Jan-03					
25-Feb-03					
4-Mar-03					
11-Mar-03	<0.2	<0.2	<0.2	<0.2	<0.2
18-Mar-03	0.3	0.2	0.3	<0.2	<0.2
25-Mar-03	0.3	N	0.2	<0.2	<0.2
29-Apr-03	0.2	<0.2	<0.2	<0.2	<0.2
27-May-03	<0.2	<0.2	<0.2	<0.2	<0.2
23-Jun-03	<0.2	<0.2	0.3	<0.2	<0.2
Min detected	0.2	0.2	0.2	0	0.2
Max	0.4	0.3	0.4	0	0.3
Mean	0.3000	0.2500	0.2800	#DIV/0!	0.2500
STDEV	0.0816	0.0707	0.0837	#DIV/0!	0.0707
Method Reporting Limit	0.2	0.2	0.2	0.2	0.2

From the data gathered, it appears that tannins and lignins contribute limited amounts to the water. A majority of the readings were below the method reporting limit of 0.2mg/L.

The mean results of the data collected indicate a slight increase downstream, although site 4f on Trout Creek was consistently below the reporting limit. Note that the highest reading was 0.4 at site 4a (the lowest site tested on Trout Creek). Tannin and lignin levels were very low in 2002-2003 (figure 21). This may be related to the dry winter, and we may find a different result from 2003-2004 work.

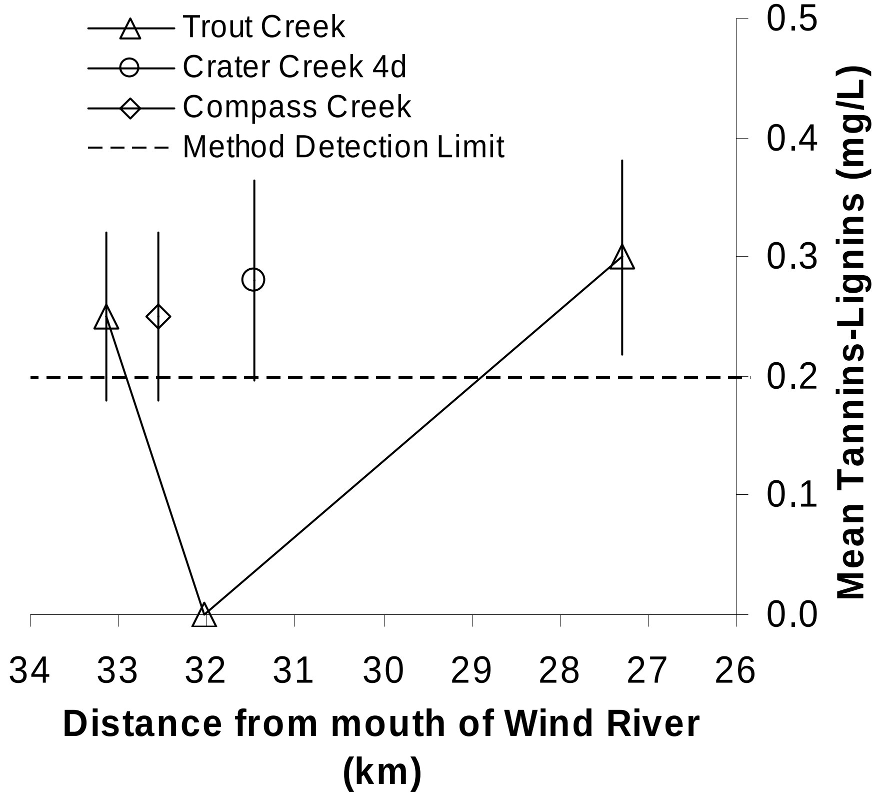

Figure 21. Mean tannin and lignin levels at each site for the sample period August 2002-June 2003. Standard deviation is displayed as vertical bars. (Note that the detection limit is 0.2 mg/L, thus the middle Trout Creek reading of 0 actually indicates a reading less than 0.2 but not necessarily zero).

Tannins and Lignins Summary

Tannin and Lignin levels appear to be very low. However, there is very little data on which to base decisions at this time. Further testing will be continued in the performance period 2003-2004.

Overall Summary

Based on the data collected so far, pH levels appear to be basic and not acidic. It also appeared to become more basic as the study progressed. Comparison with the other parameters studied indicated that the increase in pH correlated with a decrease in the sulfate levels found. Whether this is factor of seasonal conditions, or if the low snow pack received in the winter, combined with a summer drought, are the reason, will not be determined from this data. Further analysis from July 2003 through June 2004, will hopefully result in a clearer pattern of data.

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